



Tennessee Valley Authority, Post Office Box 2000, Decatur, Alabama 35609-2000

July 7, 2014

10 CFR 50.73

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

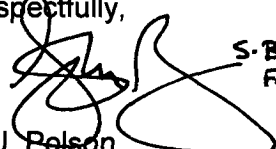
Browns Ferry Nuclear Plant, Unit 3
Renewed Facility Operating License No. DPR-68
NRC Docket No. 50-296

Subject: **Licensee Event Report 50-296/2014-002-00**

The enclosed Licensee Event Report provides details of a Browns Ferry Nuclear Plant (BFN) Unit 3 Automatic Reactor Scram that resulted from an Anticipated Transient Without Scram/Alternate Rod Insertion (ATWS/ARI) signal that was generated during functional testing of reactor water level instrumentation. The Tennessee Valley Authority (TVA) is submitting this report in accordance with 10 CFR 50.73(a)(2)(iv)(A), as any event or condition that resulted in manual or automatic actuation of any of the systems listed in paragraph (a)(2)(iv)(B), reactor protection and containment isolation systems.

There are no new regulatory commitments contained in this letter. Should you have any questions concerning this submittal, please contact J. L. Paul, Nuclear Site Licensing Manager, at (256) 729-2636.

Respectfully,


S. Bono
FOR K. Polson
7/3/14
K. J. Polson
Site Vice President

Enclosure: Licensee Event Report 50-296/2014-002-00 – Automatic Reactor Scram due to an Anticipated Transient Without Scram/Alternate Rod Insertion Signal Generated during Functional Test.

cc (w/ Enclosure):

NRC Regional Administrator - Region II
NRC Senior Resident Inspector - Browns Ferry Nuclear Plant

IE22
NRR

ENCLOSURE

**Browns Ferry Nuclear Plant
Unit 3**

Licensee Event Report 50-296/2014-002-00

**Automatic Reactor Scram due to an Anticipated Transient Without Scram/Alternate
Rod Insertion Signal Generated during Functional Test**

See Enclosed

NRC FORM 366 (02-2014)		U.S. NUCLEAR REGULATORY COMMISSION		APPROVED BY OMB NO. 3150-0104		EXPIRES 01/31/2017																																					
LICENSEE EVENT REPORT (LER)																																											
1. FACILITY NAME Browns Ferry Nuclear Plant, Unit 3				2. DOCKET NUMBER 05000296		3. PAGE 1 of 7																																					
4. TITLE: Automatic Reactor Scram due to an Anticipated Transient Without Scram/Alternate Rod Insertion Signal Generated during Functional Test																																											
5. EVENT DATE			6. LER NUMBER			7. REPORT DATE																																					
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9. OPERATING MODE <div style="text-align: center; font-size: 24px;">1</div>		11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: <i>(Check all that apply)</i> <table style="width:100%; border: none;"> <tr> <td><input type="checkbox"/> 20.2201(b)</td> <td><input type="checkbox"/> 20.2203(a)(3)(i)</td> <td><input type="checkbox"/> 50.73(a)(2)(i)(C)</td> <td><input type="checkbox"/> 50.73(a)(2)(vii)</td> </tr> <tr> <td><input type="checkbox"/> 20.2201(d)</td> <td><input type="checkbox"/> 20.2203(a)(3)(ii)</td> <td><input type="checkbox"/> 50.73(a)(2)(ii)(A)</td> <td><input type="checkbox"/> 50.73(a)(2)(viii)(A)</td> </tr> <tr> <td><input type="checkbox"/> 20.2203(a)(1)</td> <td><input type="checkbox"/> 20.2203(a)(4)</td> <td><input type="checkbox"/> 50.73(a)(2)(ii)(B)</td> <td><input type="checkbox"/> 50.73(a)(2)(viii)(B)</td> </tr> <tr> <td><input type="checkbox"/> 20.2203(a)(2)(i)</td> <td><input type="checkbox"/> 50.36(c)(1)(i)(A)</td> <td><input type="checkbox"/> 50.73(a)(2)(iii)</td> <td><input type="checkbox"/> 50.73(a)(2)(ix)(A)</td> </tr> <tr> <td><input type="checkbox"/> 20.2203(a)(2)(ii)</td> <td><input type="checkbox"/> 50.36(c)(1)(ii)(A)</td> <td><input checked="" type="checkbox"/> 50.73(a)(2)(iv)(A)</td> <td><input type="checkbox"/> 50.73(a)(2)(x)</td> </tr> <tr> <td><input type="checkbox"/> 20.2203(a)(2)(iii)</td> <td><input type="checkbox"/> 50.36(c)(2)</td> <td><input type="checkbox"/> 50.73(a)(2)(v)(A)</td> <td><input type="checkbox"/> 73.71(a)(4)</td> </tr> <tr> <td><input type="checkbox"/> 20.2203(a)(2)(iv)</td> <td><input type="checkbox"/> 50.46(a)(3)(ii)</td> <td><input type="checkbox"/> 50.73(a)(2)(v)(B)</td> <td><input type="checkbox"/> 73.71(a)(5)</td> </tr> <tr> <td><input type="checkbox"/> 20.2203(a)(2)(v)</td> <td><input type="checkbox"/> 50.73(a)(2)(i)(A)</td> <td><input type="checkbox"/> 50.73(a)(2)(v)(C)</td> <td><input type="checkbox"/> OTHER</td> </tr> <tr> <td><input type="checkbox"/> 20.2203(a)(2)(vi)</td> <td><input type="checkbox"/> 50.73(a)(2)(i)(B)</td> <td><input type="checkbox"/> 50.73(a)(2)(v)(D)</td> <td></td> </tr> </table>						<input type="checkbox"/> 20.2201(b)	<input type="checkbox"/> 20.2203(a)(3)(i)	<input type="checkbox"/> 50.73(a)(2)(i)(C)	<input type="checkbox"/> 50.73(a)(2)(vii)	<input type="checkbox"/> 20.2201(d)	<input type="checkbox"/> 20.2203(a)(3)(ii)	<input type="checkbox"/> 50.73(a)(2)(ii)(A)	<input type="checkbox"/> 50.73(a)(2)(viii)(A)	<input type="checkbox"/> 20.2203(a)(1)	<input type="checkbox"/> 20.2203(a)(4)	<input type="checkbox"/> 50.73(a)(2)(ii)(B)	<input type="checkbox"/> 50.73(a)(2)(viii)(B)	<input type="checkbox"/> 20.2203(a)(2)(i)	<input type="checkbox"/> 50.36(c)(1)(i)(A)	<input type="checkbox"/> 50.73(a)(2)(iii)	<input type="checkbox"/> 50.73(a)(2)(ix)(A)	<input type="checkbox"/> 20.2203(a)(2)(ii)	<input type="checkbox"/> 50.36(c)(1)(ii)(A)	<input checked="" type="checkbox"/> 50.73(a)(2)(iv)(A)	<input type="checkbox"/> 50.73(a)(2)(x)	<input type="checkbox"/> 20.2203(a)(2)(iii)	<input type="checkbox"/> 50.36(c)(2)	<input type="checkbox"/> 50.73(a)(2)(v)(A)	<input type="checkbox"/> 73.71(a)(4)	<input type="checkbox"/> 20.2203(a)(2)(iv)	<input type="checkbox"/> 50.46(a)(3)(ii)	<input type="checkbox"/> 50.73(a)(2)(v)(B)	<input type="checkbox"/> 73.71(a)(5)	<input type="checkbox"/> 20.2203(a)(2)(v)	<input type="checkbox"/> 50.73(a)(2)(i)(A)	<input type="checkbox"/> 50.73(a)(2)(v)(C)	<input type="checkbox"/> OTHER	<input type="checkbox"/> 20.2203(a)(2)(vi)	<input type="checkbox"/> 50.73(a)(2)(i)(B)	<input type="checkbox"/> 50.73(a)(2)(v)(D)	
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12. LICENSEE CONTACT FOR THIS LER																																											
FACILITY NAME Eric Bates, Licensing Engineer						TELEPHONE NUMBER (Include Area Code) 256-614-7180																																					
13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT																																											
CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX																																		
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ABSTRACT <i>(Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)</i>																																											
<p>On May 6, 2014, at approximately 0830 Central Daylight Time (CDT), the Browns Ferry Nuclear Plant (BFN) Unit 3 reactor automatically scrammed as a result of an Anticipated Transient Without Scram/Alternate Rod Insertion (ATWS/ARI) signal generated during functional testing of reactor water level instrumentation. The scram air header was depressurized through the ATWS/ARI valves causing all rods to insert into the core. The ATWS/ARI signal also simultaneously opened the Recirculation Pump Trip (RPT) breakers, tripping both Recirculation pumps. The loss of both pumps along with reduced core flow caused a reactor water level transient that lowered level below the Reactor Protection System (RPS) trip setpoint (+2 inches), resulting in a full reactor scram signal. Prior to this event, reactor power was 2.1 percent as all control rods were inserted by the ATWS/ARI initiation ten seconds earlier. Following receipt of the ATWS/ARI signal, all plant systems performed as required.</p> <p>The root cause of the event was that the ATWS low reactor water level Automatic Trip Unit (ATU) cards initiated a voltage transient that actuated the ATWS high reactor pressure trip due to a design anomaly.</p> <p>The corrective action to prevent recurrence includes installing time delay relays in association with the Unit 3 reactor pressure ATWS circuit.</p>																																											

**LICENSEE EVENT REPORT (LER)
CONTINUATION SHEET**

Estimated burden per response to comply with this mandatory collection request: 80 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the FOIA, Privacy and Information Collections Branch (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to Infocollects.Resource@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

FACILITY NAME (1)	DOCKET (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Browns Ferry Nuclear Plant, Unit 3	05000296	2014	- 002	- 00	2 of 7

NARRATIVE**I. Plant Operating Conditions Before the Event**

Browns Ferry Nuclear Plant (BFN), Unit 3, was in Mode 1 at approximately 100 percent power.

II. Description of Events**A. Event:**

On May 6, 2014, at approximately 0830 Central Daylight Time (CDT), the Browns Ferry Nuclear Plant (BFN) Unit 3 reactor automatically scrammed as a result of an Anticipated Transient Without Scram/Alternate Rod Insertion (ATWS/ARI) [JC] signal generated during functional testing of reactor water level instrumentation. The scram air header was depressurized through the ATWS/ARI valves causing all control rods to insert into the core. The ATWS/ARI signal also simultaneously opened the Recirculation Pump Trip (RPT) breakers, tripping both Recirculation pumps. Prior to the event, the reactor was operating at 100 percent power. A Core and Containment Cooling Systems Analog Trip Unit Functional Test was in progress. Following receipt of the ATWS/ARI signal, all plant systems performed as required.

The loss of both Recirculation pumps along with reduced core flow caused a reactor water level transient that lowered level below the Reactor Protection System (RPS) [JC] trip setpoint (+2 inches), resulting in a full reactor scram signal. Primary Containment Isolation System [JM] Groups 2, 3, 6, and 8 containment isolation and initiation signals were received. Upon receipt of these signals all required components actuated as required. Prior to the full reactor scram, reactor power was 2.1 percent due to all control rods being inserted by the ATWS/ARI initiation ten seconds earlier.

The Main Steam Isolation [SB] Valves remained open with main turbine bypass valves controlling reactor pressure. The Reactor Feedwater [SJ] pumps remained in service to control and maintain reactor water level.

B. Status of structures, components, or systems that were inoperable at the start of the event and that contributed to the event:

There were no structures, components, or systems that were inoperable at the start of the event and that contributed to the event.

C. Dates and approximate times of occurrences:

May 6, 2014, at 0406 CDT

Core and Containment Cooling
Systems Analog Trip Unit Functional
Tests Surveillance started.

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NARRATIVE

May 6, 2014, at 0830 CDT

ATWS Channel A signal received on Unit 3 and control rod insertion commenced due to the actuation of the ARI solenoid valves by the ATWS signal. The ATWS/ARI signal also simultaneously opened the Recirculation pump trip breakers, tripping both Recirculation pumps. Core and Containment Cooling Systems Analog Trip Unit Functional Testing stopped.

May 6, 2014, at 1227 CDT

The BFN reported the event to the NRC.

D. Manufacturer and model number (or other identification) of each component that failed during the event:

No component failures were identified that occurred during the event. However, as a part of troubleshooting and further analysis, the Automatic Trip Unit (ATU) power supply and slave card were replaced due to the inability to eliminate either as the causing component at that time.

E. Other systems or secondary functions affected:

There were no other systems or secondary systems affected.

F. Method of discovery of each component or system failure or procedural error:

During the performance of a Functional Test on the Unit 3 reactor water level instrumentation, the Anticipated Transient Without a Scram Recirculation Pump Trip (ATWS-RPT) relay unexpectedly actuated resulting in dual Recirculation Pump trip.

G. The failure mode, mechanism, and effect of each failed component, if known:

During the investigation, it was determined that the ATWS low reactor water level ATU cards initiated a voltage transient that actuated the ATWS high pressure trip.

H. Operator actions:

There were no immediate operator actions since all automatic protective functions performed as required. However, operators entered plant procedures 3-AOI-100-1, 3-EOI-1, 3-OI-2, 3-OI-47, and 3-OI-75 to address the plant transients.

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NARRATIVE**I. Automatically and manually initiated safety system responses:**

Following the receipt of the ATWS/ARI signal, all systems performed as required.

III. Cause of the event**A. The cause of each component or system failure or personnel error, if known:**Direct Cause

The direct cause of the Unit 3 automatic reactor scram on May 6, 2014, was the spurious energizing of ATWS relay 3-58C5 during simulation of a low reactor water level.

Root Cause

The root cause was that the ATWS low reactor water level ATU cards initiated a voltage transient that actuated the ATWS high reactor pressure trip due to a design anomaly.

B. The cause(s) and circumstances for each human performance related root cause:

There was no human performance related root cause.

IV. Analysis of the event:

The Tennessee Valley Authority (TVA) is submitting this report in accordance with 10 CFR 50.73(a)(2)(iv)(A), as any event or condition that resulted in manual or automatic actuation of any of the systems listed in paragraph (a)(2)(iv)(B), reactor protection and containment isolation systems.

On May 06, 2014 at 0830 CDT, Unit 3 ATWS/ARI was unexpectedly initiated during the performance of 3-SR-3.3.5.1.2 (ATU A). The initiation occurred as a reactor water level switch (3-LS-3-58A1) was being functionally tested by simulating a lowering reactor water level. Contrary to the test intent, once the setpoint was reached ATWS initiation occurred. As a result the scram air header was depressurized through the ATWS/ARI valves, causing all control rods to insert into the core. The ATWS/ARI signal also simultaneously opened the RPT breakers, tripping both pumps. The loss of both Recirculation pumps along with reduced core flow caused a reactor water level transient that lowered level below the RPS trip setpoint (+2 inches), resulting in a full reactor scram signal. Prior to the event, reactor power was 2.1 percent due to all control rods being inserted by the ATWS/ARI initiation ten seconds earlier. Following receipt of the ATWS/ARI signal, all plant systems performed as required.

Immediately after the plant trip, testing was stopped with test equipment configuration unchanged. Eleven minutes after the scram Maintenance supervision verified all test

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NARRATIVE

equipment was in the expected position and all procedure steps were performed as written. No active human performance errors were identified. The test procedure was also reviewed with no deficiencies identified. The test equipment used during performance of the Surveillance was tested and found to be within calibration and functioning correctly. Post-scam testing/troubleshooting revealed a number of potential causes.

Testing confirmed that simultaneous actuation of the high reactor pressure relays via a voltage transient as the failure that occurred and is the root cause. Testing validated that a General Electric (GE) ATU card in one circuit could transmit a spurious voltage signal (crossover) to other cards in a separate circuit when the card under test is tripped (in this case by simulating a low water level as part of the functional test). The signal produced by the actuation of the GE ATU cards and subsequent actuation of the low reactor water level relays was of sufficient magnitude and duration to trip the high reactor pressure relays due to the close proximity of the trip setpoint and normal on-line indication for reactor pressure (6-7 percent). The high reactor pressure relays are also more susceptible to this type of perturbation because they are instantaneous, unlike the low reactor water level relays, which have a time delay of 750 milliseconds that allows short-lived transients to pass without initiating ATWS.

The production of the voltage transient has been isolated to an anomaly of the GE master/slave cards in the ATWS circuitry. Discussion with GE confirmed this anomaly is a characteristic of the cards and not necessarily a defect. However, a defect could not be ruled out; so those cards will be replaced with new ones as a precaution. Rosemount cards have not shown the same susceptibility and are the only other card manufacturer used in this application at BFN and do not need to be replaced. The GE cards were utilized to add diversity to the reactor trip logic.

The absence of the ATWS Test Switch in the ATU functional tests was evaluated and determined to not be causal to the event. The purpose of the test switch is to prevent actuation of ATWS during testing that would produce an ATWS initiation signal (i.e. ATWS logic tests). The surveillance being run in this event was a functional test that affects only half of the logic and is not intended to actuate the ATWS relay. Review of external and internal operating experience has not found another instance of the phenomenon observed for a similar event. Therefore, the use of the test switch was not considered previously and should not have been considered based on accepted industry test practices and operational experience.

V. Assessment of Safety Consequences

There were no actual safety consequences associated with this event as the plant response was within expected design values and the plant equipment functioned properly during and after the scram.

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NARRATIVE

Based on the discussion above, the safety significance of this event is low and the event did not pose a threat to the health and safety of the public or plant personnel.

Nuclear Safety was maintained by the automatic protective functions in the circuitry that resulted in the scram followed by appropriate operator actions based on procedural requirements.

A. Availability of systems or components that could have performed the same function as the components and systems that failed during the event:

The A and B channels of ATWS are redundant and operate identically. Therefore, there is no other component that could have performed the same function available.

B. For events that occurred when the reactor was shut down, availability of systems or components needed to shutdown the reactor and maintain safe shutdown conditions, remove residual heat, control the release of radioactive material, or mitigate the consequences of an accident:

The BFN Unit 3 was not shut down when this event occurred.

C. For failure that rendered a train of a safety system inoperable, an estimate of the elapsed time from discovery of the failure until the train was returned to service:

This event did not render a train of a safety system inoperable.

VI. Corrective Actions

Corrective Actions are being managed by TVA's corrective action program under Problem Evaluation Report (PER) 881051.

Immediate Corrective Actions

The ATU power supply was replaced along with the slave card due to the inability to eliminate either as the causing component at that time.

Interim Corrective Actions

Revise Core and Containment Cooling Systems Analog Trip Unit Functional Test procedures to include use of the ATWS Test Switch and the High Reactor Water Level Bypass Switch to protect the plant from inadvertent actuation during testing.

Corrective Actions to Prevent Recurrence or to Reduce Probability of Similar Events Occurring in the Future

- Install time delay relays in association with the reactor pressure ATWS circuit on BFN Units 1, 2, and 3.
- Replace the GE Master and Slave ATU cards associated with the initiating event.

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NARRATIVE

VII. Additional Information:

A. Previous similar events at the same plant:

A search of the BFN self-assessment data base was conducted. The search was for issues relevant to ATWS-RPT system SCRAMS. The period between 2010 and 2014 was searched. The search of the self-assessment database yielded no results applicable to this issue.

B. Additional Information:

There is no additional information.

C. Safety System Functional Failure Consideration:

In accordance with Nuclear Energy Institute (NEI) NEI 99-02, "Regulatory Assessment Performance Indicator Guideline," this event is not considered a safety system functional failure.

D. Scram with Complications Consideration:

This event did not result in an unplanned scram with complications because:

1. RPS actuation established a shutdown rod pattern for a cold clean core;
2. Pressure control was able to be established following the initial transient;
3. Power was not lost to any Class 1E Emergency / Engineered Safety Feature bus;
4. A Level 1 Injection signal was not received;
5. Main Feedwater was available or recoverable using approved plant procedures during the scram response; and
6. Following initial transient, stabilization of reactor pressure/level and drywell pressure did not require remaining in the Emergency Operating Procedures.

VIII. COMMITMENTS

There are no commitments.